

ASERS

Journal of Environmental Management and Tourism

Quarterly

Volume XII

Issue 4(52)

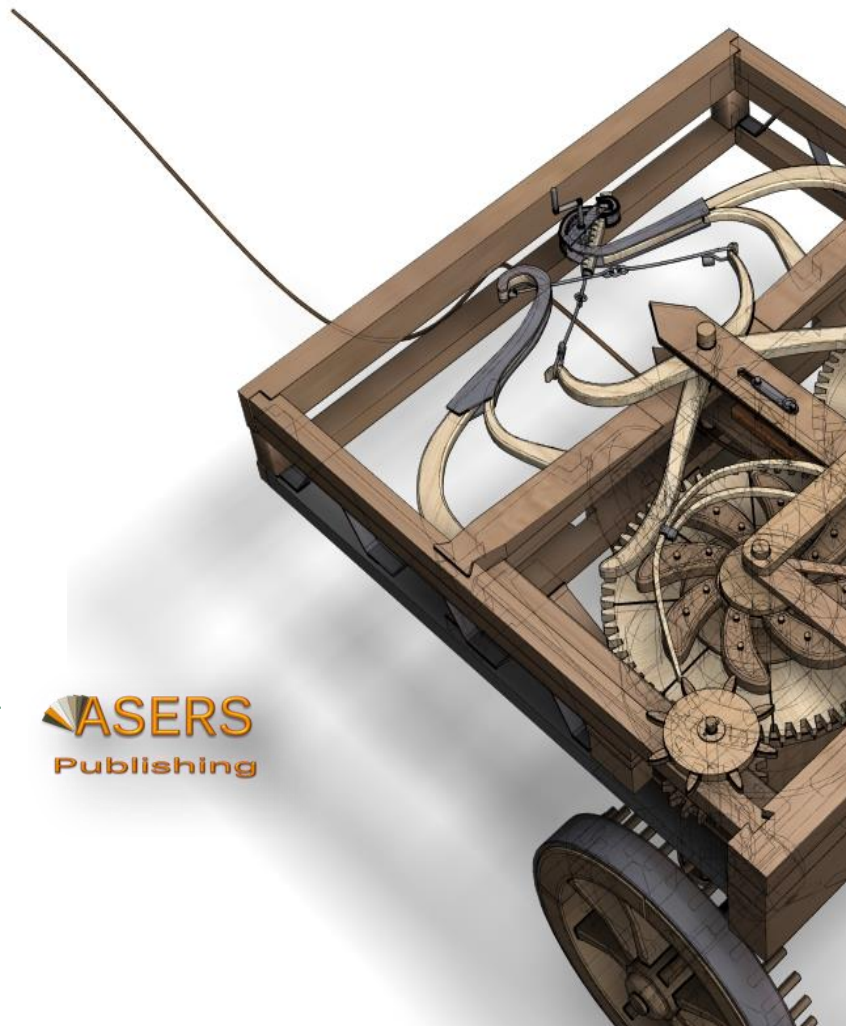
Summer 2021

ISSN 2068 – 7729

Journal DOI

<https://doi.org/10.14505/jemt>

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ISSN 2068 – 7729

Journal DOI: <https://doi.org/10.14505/ient>

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Journal of Environmental Management and Tourism is an interdisciplinary research journal, aimed to publish articles and original research papers that should contribute to the development of both experimental and theoretical nature in the field of Environmental Management and Tourism Sciences.

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DOI: [https://doi.org/10.14505/jemt.v12.4\(52\).25](https://doi.org/10.14505/jemt.v12.4(52).25)

Biodiversity of Birds in Urban Green Space for Support Ecotourism activities in Valaya Alongkorn Rajabhat University Thailand

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Suggested Citation:

Boruah, I., *et al.* (2021). Biodiversity of Birds in Urban Green Space for Support Ecotourism Activities in Valaya Alongkorn Rajabhat University Thailand. *Journal of Environmental Management and Tourism*, (Volume XII, Summer), 4(52): 1131 - 1138. DOI:[10.14505/jemt.v12.4\(52\).25](https://doi.org/10.14505/jemt.v12.4(52).25)

Article's History:

Received 4th of April 2021; Received in revised form 21st of April 2021; Accepted 18th of May 2021; Published 21st of June 2021. Copyright © 2021 by ASERS® Publishing. All rights reserved.

Abstract:

Bird watching is one of the attractive ecotourism activities for travelers and nature enthusiasts, which rapidly growing in Thailand. This study aims to: (1) explore bird diversity in various green spaces in ValayaAlongkorn Rajabhat University (VRU); and (2) examine which bird species dominates the study areas. Bird data were collected using point count techniques in two sessions; early morning, and late afternoon, at VRU from May 2020 to April 2021. Frequency of occurrence value (FQ) was analyzed for classifying status groups of birds in the VRU. Order Passeriformes was numerically the dominant order in our study area, with 22 species (47.7% of total represented species), while the other bird orders were the least dominant, represented by 1 to 5 species in range. A total of 47 species of birds belonging to 29 Families and 12 Orders were recorded. During this study, significantly, the highest bird richness was recorded in agriculture areas (35 ± 2.3 SD), followed by the species from recreation areas (27 ± 1.8 SD) and natural wetland (17 ± 1.7 SD) ($P > 0.05$). Five migrant bird species and 35 resident species were observed, and 10 bird species were recorded in both the seasonal status as migrant and resident species. Most of the bird species are listed as of least concern, while only one species, *Mycteria leucocephala*, are listed as near-threatened. Nine bird species are classified as common species in the VRU with $> 80\%$ of frequency of occurrence. The pattern of bird diversity in the VRU in general follows the natural condition of green area space in the VRU. Typical characteristics of birds, their habitat and appearing period can develop bird-watching objects, which become interesting attractions for travelers and nature enthusiasts, promoting ecotourism development and efforts to conserve bird diversity.

Keywords: bird biodiversity; birdwatching; urban ecosystem; urban ecotourism.

JEL Classification: Q56; Q57; Z32.

Introduction

Travel and tourism play an important role improving the economic status of a developing country (Maxim 2016). Ecotourism is the most important form of tourism (Diamantis 2010). The study focuses on the proper use of naturally available resources for the benefit of tourism. It emphasizes the preservation of natural habitat of the living beings, while attracting tourists to the place. Ecotourism promotes sustainable travel, benefitting local communities, their culture and heritage, and the environment (Chan, Bhatta 2013). It can help in sustainable protection of the environment. A tourist can get to know the natural way of life of people, animals, and birds. Thus, ecotourism helps in conserving natural resources and in boosting the development of tourism. It increases a sense of responsibility among travelers, while educating the local community. It can provide environmental education, which will contribute to the conservation of biodiversity (Hakim 2017).

Birds are highly important in the overall functioning of various ecosystems. By contributing to the health of an ecosystem, birds can provide several direct benefits to humans. Birds are common in most habitats and are ecologically significant. High diversity of bird species is indicative of a potential attraction that can be developed for ecotourism, besides other natural attractions. Bird- and animal-watching are among the most popular ecotourism activities (Whelan *et al.* 2008). They are done using devices or optical aids which help people to see and study wildlife (Puhakka *et al.* 2015). Birds reside in the ValayaAlongkorn Rajabhat University (VRU) and the natural habitat of such animals is being developed by protecting the environment and boosting ecotourism in the University. Moreover, feeding stations are set up to attract birds, making them easily observable. Further steps include the assessment of the existing bird species, area topology as the birds' habitat, and appropriate land use for the establishment of bird-watching activity (Puhakka *et al.* 2015). Birds are wildlife that can be found easily in almost all environments. Birds are among the key components of the earth's biodiversity, as they are potential indicators of ecosystem health. They play a major role in pollination; they are consumers of plant seed and act as a predator of insects (Kiros *et al.* 2018). Birds are well-known bio-indicators, and have a significant role in both the structure and function of ecosystems, by providing numerous ecological benefits. Birds are an ideal study group for the valuation of ecosystem services (Tanalgo *et al.* 2015) and the most diverse groups of ecosystem service providers, whose ecological functions range from creating soil to shaping primate behaviour. Nevertheless, the impression that birds have little influence on ecological processes has been hard to change (Sekercioglu 2006). However, a few studies have reported that bird diversity play an important role as naturally available resources in the city's green space, which can aid recreational activities to support the ecotourism program. Birds are one of the most common types of wildlife in urban areas, and many bird populations have been declining as a result of landscape changes due to urban expansion, due to high rates of land conversion for urban uses and increasing human pressure on biodiversity due to rapid population growth (Gatesire *et al.* 2014). As urban areas expand, understanding how ecological processes function in cities has become increasingly important for conserving biodiversity. Urban areas can support endemic native species and others of conservation concern, both at regional and global scales (Lepczyk *et al.* 2017). Callaghan *et al.* (2018) reported that all areas of green space are the most important predictors of bird biodiversity, underlining the critical importance of habitat area for increasing bird biodiversity and mitigating loss from urbanization. Landscape-scale habitat predictors are less related to bird biodiversity than local-scale habitat predictors. Eventually, bird biodiversity loss could be mitigated by protecting and developing large green spaces with varied habitat in the world's cities.

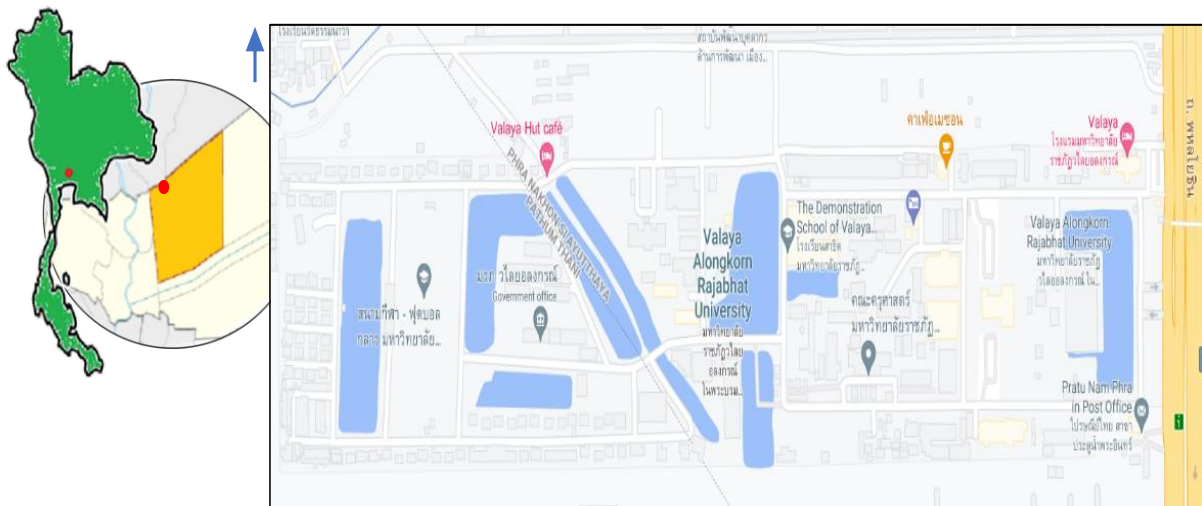
The aim of this study was to explore bird diversity in various green spaces at VRU. The second purpose was to examine which bird species dominated the study areas. The final goal of this study was to evaluate the benefit of birds in urban green space for Support Ecotourism activities in the VRU.

1. Materials and Methods

1.1. Study Site

The study was carried out within ValayAlongkorn Rajabhat University (VRU), Pathum Thani Province, Thailand. The VRU covers a total area of 61 hectares, a low-lying city with an approximate elevation of 1.7 metres above sea level. Annual mean temperature ranges from 14°C to 45°C at the meteorological station in Pathum Thani, with the average relative humidity being 36 ± 12.4 SD and air temperature 37.65 ± 8.6 SD °C. Inside the VRU, most of the campus roads and buildings along the campus are planted with wood trees, shrub, herb, and small yards. The external area consists of rice field, industrial estate and main road, at a distance of 30 km from the Bangkok metropolitan area (Figure 1).

Figure 1. Study site of ValayaAlongkorn Rajabhat University (VRU), Pathum Thani Province Thailand.



1.2. Habitat Classification

Three study areas were chosen based on the distribution of plots across the micro-landscape, viz., natural wetland (NW), agriculture areas (AA) and recreation zone (RA) (Figure2). Natural wetland (NW) is dominated by sacred lotus (*Nelumbo nucifera* Gaertn) and is surrounded by residential areas, rice fields and walking trail. Recreation areas (RA) are areas open for recreational purposes, such as walking, riding, boating, exercise education, relaxation, refreshment, and sport. Habitat areas include walking trail, man-made pool, coffee shop, open area for group-activity and sport and green spaces covered by tall trees and yards. Agricultural area (AA) consists of area used for organic farming, banana plantations and rice fields.

Figure 2. Three habitat classifications in the micro-landscape of the study area: Natural Wetland (NW), Agriculture Areas (AA) and Recreation Zone (RA)



1.3. Sampling Method

Data collection related to birds was done using point and line transect techniques. Line transects of approximately 2 km, which had ten points, were established as observation point for bird species. At each observation point, bird species were observed within 10 minutes by using a binocular with a single observer to avoid inter-observer variability (Buckland *et al.* 2001), and data of birds' activity were recorded during 10 min in at arrival time, departure time, weather conditions, vegetation cover, and any kind of disturbance (e.g. presence of and noise from humans or vehicles).

Bird observation times were divided in two sessions a day, based on bird activity. The first session was conducted in the early morning (6:00-10:00 a.m.), and the second session in the late afternoon (4:00-6:00 p.m.). The study was conducted six times within a year, from May 2020 to April 2021.

1.4. Bird Identification

Birds were identified into species based on taxonomical classification at each point by using *Birds of Thailand* (Treesucorn and Limparungpatthanakij 2018) and other standard references. In the case of birds which could not

be identified in the field, their photo was recorded by a high-resolution camera, along with descriptive notes for later identification by a bird expert at Thai Natural Sciences Museum. The seasonal and conservation status was classified based on the International Union for Conservation of Nature (IUCN) Red List.

1.5. Statistical Analysis

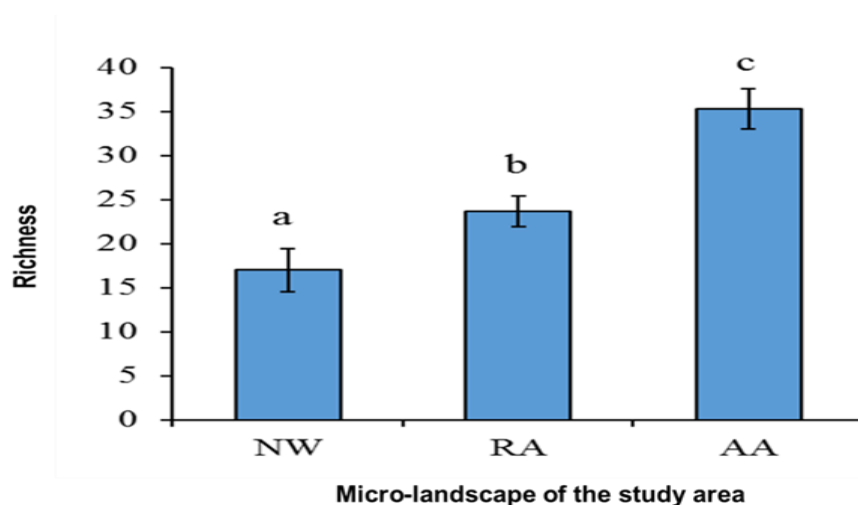
The total number of the bird species determines the species richness. The dominant birds express the proportional importance of the assemblage species, indicated by the value of frequency of occurrence (F) of each species at each study area separately, which was calculated as $F = ni/N \times 100$. As a result, the birds could be divided into three groups. First, F value between 0%- 35% was considered as uncommon species; second, F value between 36%-70% was considered as common species, and finally, F value between 71%-100% was considered as the dominant species. Univariate ANOVA was conducted to compare the richness among study areas, and pair-wise comparisons (LSD post-hoc tests) were performed when the differences were considered significant at $P < 0.05$. All data were transformed to reduce heteroscedasticity of the analysis. ANOVA statistical analyses were performed with PASW ver. 20.0.0 for Windows (SPSS Inc., Chicago, IL, USA).

2. Result

2.1. The Richness of Bird

A total of 47 bird species belonging to 29 families and 12 Orders were observed from the study areas at the VRU (Table 1). Order Passeriformes was numerically the dominant order, represented by 15 families and 22 species, accounting for 49% of the identified species, followed by Columbiformes (9%) and Cuculiformes (9%); other orders were found with the least diversity with 1-2 species (Table 1). Significantly high bird richness was recorded in the AA with 35 ± 2.3 SD, vis-a-vis RA (27 ± 1.8 SD) and the NW (17 ± 2.5 ; SD Fig. 3; $p > 0.05$).

Figure 3. Mean ($\pm$ SD) of richness of birds in three micro-landscapes in the study area, Natural Wetland (NW), Recreation Areas (RA) and Agricultural area (AA). Significant values are indicated with difference in letters with $p < 0.001$



The figure 3 shows the highest richness of bird species per plot visit. The highest richness of bird species was found in AA, RA, and NW. The AA area is an agricultural field with less interference, with grain crops, agricultural products such as rice, etc., while the NW is a large lotus pond without other plants. Therefore, only some species of bird species are available around the wetland (Table 1).

2.2. Status of Birds in the VRU

Five migrant bird species and 35 resident species were observed, and the seasonal status of 10 bird species was recorded both as migrant and resident species. Most of the bird species are listed of low concern, and only one species, *Mycteria leucocephala* was listed as near-threatened (Table 1).

Table 1. Species richness and the frequency of bird occurrence within the study areas - Natural wetland (NW), Recreation areas (RA), Agricultural area (AA) -, and a seasonal status.

Order/Family/species		frequency of occurrence (%; N=6)			Seasonal status
		NW	RA	AA	
Anseriformes					
	Anatidae				
	<i>Dendrocygnajavanica</i> (Horsfield 1821)	0	100	0	RS
Apodiformes					
	Apodidae				
	<i>Cypsiurusbalasiensis</i> (J.E. Gray 1829)	0	100	100	RS
Ciconiiformes					
	Ciconiidae				
	<i>Anastomusoscitans</i> (Boddaert, 1783)	83	17	100	RS
	<i>Mycteria leucocephala</i> (Pennant 1769)	0	100	100	RS
Columbiformes					
	Columbidae				
	<i>Columba livia</i> (Gmeline 1789)	100	100	100	RS
	<i>Geopelia Striata</i> (Linnaeus, 1766)	50	100	100	RS
	<i>Streptopelia chinensis</i> (Scopoli 1768)	33	100	67	RS
	<i>Streptopeliatranquebarica</i> (Hermann 1804)	67	100	100	RS
Coraciiformes					
	Alcedinidae				
	<i>Alcedoatthis</i> (Linnaeus 1758)	0	100	50	MS
	<i>Halcyon pileata</i> (Boddaert 1783)	0	0	100	MS
	Meropidae				
	<i>MeropsOrientalis</i> (Latham 1801)	0	100	100	RS
Cuculiformes					
	Cuculidae				
	<i>Cacomantismerulinus</i> (Scopoli 1786)	0	0	100	RS
	<i>Centropus sinensis</i> (Stephens, 1815)	50	0	0	RS
	<i>Chrysococcyx maculatus</i> (Gmelin 1788)	50	0	50	RM
	<i>Eudynamysscolopaceus</i> (Linnaeus, 1758)	33	83	83	RS
	<i>Phaenicophaeus tristis</i> (Lesson 1830)	50	17	0	RS
Gruiformes					
	Rallidae				
	<i>Amauornisphoenicurus</i> (Pennant 1769)	33	0	100	RS
Passeriformes					
	Artamidae				
	<i>Artamusfuscus</i> (Vieillot 1817)	0	50	17	RS
	Campephagidae				
	<i>Pericrocotuscinnamomeus</i> (Linnaeus 1766)	0	100	0	RS
	Cisticolidae				
	<i>Priniainornata</i> (Sykes 1832)	0	0	100	RS
	Corvidae				
	<i>Corvus macrorhynchos</i> (Wagler 1827)	33	67	100	RS
	Dicaeidae				
	<i>Dicaeumcruentatum</i> (Bonaparte 1853)	67	0	100	RS
	Dicruridae				
	<i>Dicrurusleucophaeus</i> (Vieillot 1817)	33	0	0	RM
	<i>Dicrurusmacrocerus</i> (Vieillot 1817)	0	0	100	RM
	Estrildidae				
	<i>Lonchurapunctulata</i> (Linnaeus 1758)	17	17	100	RS
	<i>Lonchura striata</i> (Linnaeus 1766)	33	33	100	RS
	Hirundinidae				
	<i>Hirundorustica</i> (Linnaeus 1758)	17	50	0	RM
	Laniidae				
	<i>Laniuscristatus</i> (Linnaeus 1758)	0	0	50	MS

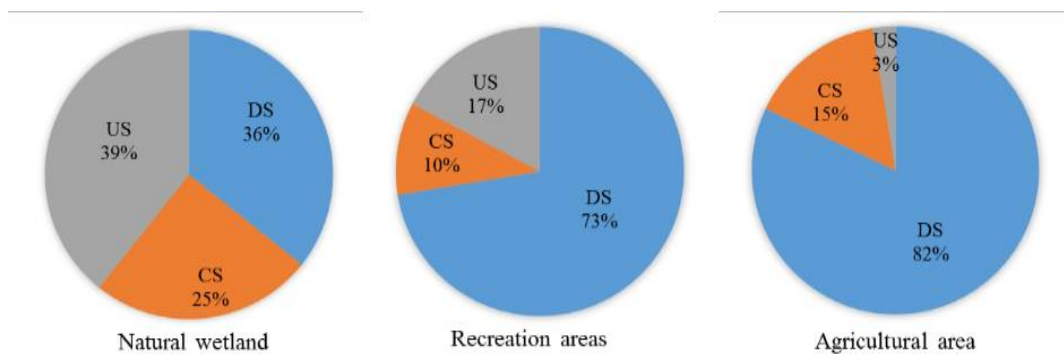
Order/Family/species		frequency of occurrence (%; N=6)			Seasonal status
		NW	RA	AA	
	Motacillidae				
	<i>Anthushodgsoni</i> (Richmond 1907)	17	0	0	MR
	Muscicapidae				
	<i>Copsychussaularis</i> (Linnaeus 1758)	100	100	100	RS
	<i>Muscicapadaurica</i> (Pallas 1811)	33	0	100	RM
	Nectariniidae				
	<i>Cinnyris jugularis</i> (Linnaeus 1766)	33	33	67	RS
	Passeridae				
	<i>Passer domesticus</i> (Linnaeus 1758)	0	100	100	RS
	<i>Passer montanus</i> (Linnaeus 1758)	100	100	100	RS
	Ploceidae				
	<i>Ploceushypoxanthus</i> (Sparrman 1788)	50	0	100	RS
	Pycnonotidae				
	<i>Pycnonotusblanfordi</i> (Finsch 1873)	100	100	100	RS
	<i>Pycnonotusgoiavier</i> (Scopoli 1786)	50	0	0	RS
	Sturnidae				
	<i>Acridotheres grandis</i> (Cabanis 1850)	100	100	100	RS
	<i>Acridotheres tristis</i> (Linnaeus 1766)	100	100	100	RS
	<i>Sturnus contra</i> (Gmelin 1789)	0	100	100	RS
Passerine					
	Oriolidae				
	<i>Oriolus chinensis</i> (Linnaeus 1766)	0	0	50	RM
	Rhipiduridae				
	<i>Rhipidurajavanica</i> (Sparrman 1788)	0	100	100	RM
Pelecaniformes					
	Ardeidae				
	<i>Ardeolabacchus</i> (Bonaparte 1855)	100	100	100	MS
	<i>Egretta garzetta</i> (Linnaeus 1766)	100	0	100	RS
	<i>Ixobrychus sinensis</i> (Gmelin 1789)	0	0	100	RS
Piciformes					
	Megalaimidae				
	<i>Psilopogonhaemacephalus</i> (Statius Müller 1776)	0	100	100	RS
Suliformes					
	Phalacrocoracidae				
	<i>Microcarboniger</i> (Vieillot 1817)	100	0	100	RS
	Total number of species	29	29	39	
	Total number of order: 12 order				
	Total number of family: 29 family				

Remark: A seasonal status were indicated by Treesucorn and Limparungpatthanakij (2018), which RS = Resident species, MS = Migrated species, RM = both status; resident species and migrated species.

2.3. The Frequency of Occurrence (F)

Frequency of occurrence (F) was used to evaluate the bird status in the VRU, classifying birds as uncommon species, common species, and dominant species. Nine bird species - *Columba livia* (100%), *Copsychussaularis* (100%), *Passer montanus* (100%), *Pycnonotusblanfordi* (100%), *Acridotheres grandis* (100%), *Acridotheres tristis* (100%), *Ardeolabacchus* (100%), *Streptopelia tranquebarica* (89%) and *Geopelia striata* (83%) - were classified as common species in the VRU with > 80 % of the F. There are differences in the proportion of the bird groups found in each study area. Natural wetland had a larger value of uncommon and dominant species with 39 % and 36 % respectively and 25 % was recorded for common species. Interestingly, few values of the uncommon species were found in the NW and the AA (Figure 4).

Figure 4. The proportion of three bird species groups - uncommon species (US), common species (CS) and dominant species (DS) - found in each study areas



3. Discussion

The study result indicated the prevalence of large bird diversity in the AA. This may be due to the AA in this study representing cultivating area of various food sources such as floral plants, banana, rice seed, papaya, and being a habitat for the birds due to the use of organic farming systems, with a small pond and canals with insects, fish, small rodents, amphibians, and reptiles. Thus, the presence of abundant food resources and habitat complex, with various microhabitats might be the determining factor for the relatively high diversity in the AA, especially since the birds' feeder group being dominant in the area comprises Insectivorous, Nectarous and frugivorous birds. In general, a habitat and food source can determine bird diversity, as suggested by Johnson (2001); Mansor *et al.* (2012); Peh *et al.* (2006); and Tu *et al.* (2020). This observation revealed that bird diversity is different among habitats in green area space in the urban ecosystem, which might correspond to the human-disturbance environment (e.g., building area, small park, rural area, road, organic farming areas and pond) to the natural environment (i.e., lotus pond) (Gatesire *et al.* 2014; Kiros *et al.* 2018).

The results relating to the status of birds in the VRU can support the idea of birds tolerating human intrusions into the habitat. The larger portion of dominant bird species was found in the AA (82%) and the RA (73%), comprised birds that can be found throughout year. Thus, a daily activity of humans has possibly no influence on the presence of birds in the AA and the RA, even of migratory species. In summary, the bird species dominant in the study area were generalist species and belonging to Insectivorous, Nectarous and frugivorous groups, while a few species were special species such as water birds, bee-hunting birds, etc. The hypothesis of some that bird species inhabit open field's more than built-up areas, was not supported in this study. This may be since some built-up areas, including institutional grounds and residences were specifically designed with plant communities to attract birds. Alternatively, some micro-landscapes within open fields have a low number of species such as NW, which is a wetland habitat and does not facilitate airplane landing. This habitat offers little food and is an unsuitable habitat for most bird species (Gatesire *et al.* 2014).

Conclusion and Recommendation

The diversity of birds in the VRU might be influenced by the land use by humans and the kind of food and nest available for birds. Thus, the conservation of diversity of birds and their food sources such as insects, amphibians and reptiles should be done on a larger scale at the VRU. The pattern of bird diversity in the VRU, in general follows the natural condition of the green area space in the VRU. Typical characteristics of birds, their habitats and appearing period can develop bird watching, which is an interesting attraction for travellers and nature enthusiasts, contributing to ecotourism development and to the efforts to conserve bird diversity.

Acknowledgement

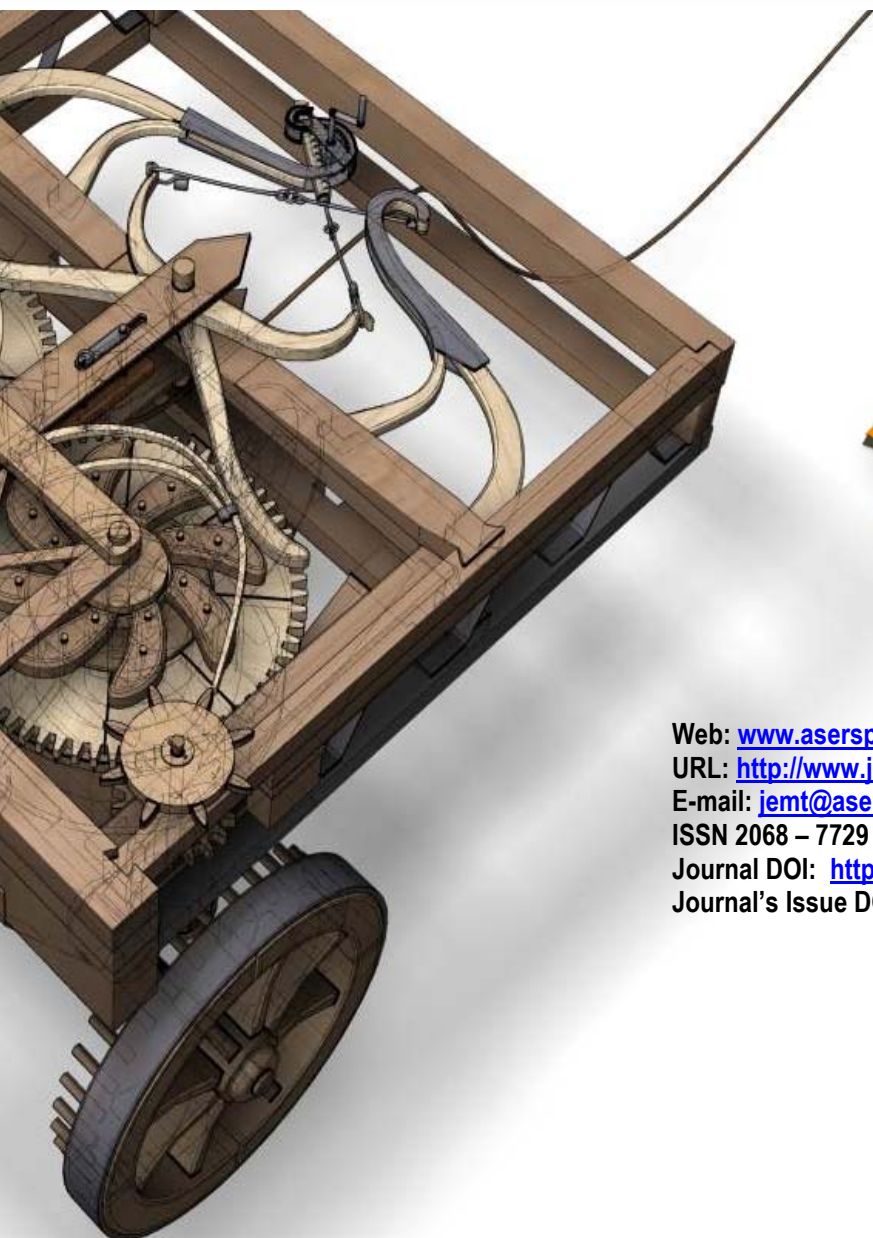
This study was supported by full scholarship to study from the Valaya Alongkorn Rajabhat University under the Royal Patronage, and partially supported by Assoc. Prof. Dr. Issara Suwanabol.

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ISSN 2068 – 7729

Journal DOI: <https://doi.org/10.14505/jemt>

Journal's Issue DOI: [https://doi.org/10.14505/jemt.v12.4\(52\).00](https://doi.org/10.14505/jemt.v12.4(52).00)